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anode and reference in 1M LiPF₆ in EC/DMC (1:1 v/v) (ethyl carbonate/dimethyl carbonate) electrolyte were assembled in a glove box (Mbraun, Inc.) filled with ultra highly purity (UHP) argon. The electrochemical performance of the TiO₂/graphene anode was then evaluated using an Arbin Battery Tester BT-2000 (Arbin Inst., College Station, Tex.) at room temperature. The half-cell was tested between 3V and 1V vs. Li at various C rate current based on a theoretical capacity of 168 mAh/g (i.e., 1 C=168 mAh/g-1) for anatase.

FIGS. 1-4 show the measured specific capacity at various C rates and voltage profiles for the half cells prepared using this method. FIGS. 1 and 2 were measured on titania/graphene composites made from graphene with an average particle size of 2.6 μm. The samples had high initial capacity (>170 mAh/g at C/10) and good rate capability (>100 mAh/g at 2 C). Less than 5% capacity fade occurred after 200 cycles at 1 C, after which the fading rate increased slightly. The sample retained a specific capacity of approximately 100 mAh/g after 400 hours cycling at 1 C.

The data in FIGS. 3 and 4 was collected on titania/graphene composites made from graphene with an average particle size of 11.6 μm. These samples had even better specific capacity, rate performance and cycling stability than those prepared using the smaller (2.6 μm) graphene particles. Negligible fade occurs after 400 cycles at 1 C in these samples. While the invention has been illustrated and described in detail in the drawings and foregoing description, the same is to be considered as illustrative and not restrictive in character. Only certain embodiments have been shown and described, and all changes, equivalents, and modifications that come within the spirit of the invention described herein are desired to be protected. Any experiments, experimental examples, or experimental results provided herein are intended to be illustrative of the present invention and should not be considered limiting or restrictive with regard to the invention scope. Further, any theory, mechanism of operation, proof, or finding stated herein is meant to further enhance understanding of the present invention and is not intended to limit the present invention in any way to such theory, mechanism of operation, proof, or finding.

Thus, the specifics of this description and the attached drawings should not be interpreted to limit the scope of this invention to the specifics thereof. Rather, the scope of this invention should be evaluated with reference to the claims appended hereto. In reading the claims it is intended that when words such as "a", "an", "at least one", and "at least a portion" are used there is no intention to limit the claims to only one item unless specifically stated to the contrary in the claims. Further, when the language "at least a portion" and/or "a portion" is used, the claims may include a portion and/or the entire items unless specifically stated to the contrary. Likewise, where the term "input" or "output" is used in connection with an electric device or fluid processing unit, it should be understood to comprehend singular or plural and one or more signal channels or fluid lines as appropriate in the context. Finally, all publications, patents, and patent applications cited in this specification are herein incorporated by reference to the extent not inconsistent with the present disclosure as if each were specifically and individually indicated to be incorporated by reference and set forth in its entirety herein.

The invention claimed is:

1. A method for forming a nanocomposite material comprising the steps of:
 - dispersing graphene with a surfactant forming a first mixture;

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providing a metal oxide in an aqueous solution to form a second mixture;

adding the second mixture to the first mixture to form a metal oxide and graphene nanocomposite;

adding the metal oxide and graphene nanocomposite to a solvent to form a suspension;

applying the suspension to a current collector; and evaporating the solvent to form a dried metal oxide and graphene nanocomposite material wherein the metal oxide is in electrical communication with at least one graphene layer.

2. The method of claim 1 wherein the solvent is an organic solvent.

3. The method of claim 1 wherein the metal oxide is titania.

4. The method of claim 1 wherein the titania is provided as particles having an average diameter below 50 nm.

5. The method of claim 1 wherein the titania is provided as particles having an average diameter below 10 nm.

6. A method for forming a nanocomposite material comprising the steps of:

dispersing graphene with a surfactant forming a first mixture;

providing an aqueous second mixture of metal oxide;

adding the second mixture to the first mixture to form a metal oxide and graphene nanocomposite;

adding the metal oxide and graphene nanocomposite to solvent to form a suspension, applying the suspension to a current collector,

evaporating the solvent to form an anode,

connecting the anode to a cathode having lithium ions and an electrolyte to form a battery, and

electrochemically cycling the anode to form a nanocomposite material comprising at least one metal oxide in electrical communication with at least one graphene layer.

7. The method of claim 6 wherein the solvent is an organic solvent.

8. The method of claim 6 wherein the metal oxide is titania.

9. The method of claim 6 wherein the titania is provided as particles having an average diameter below 50 nm.

10. The method of claim 6 wherein the titania is provided as particles having an average diameter below 10 nm.

11. A method for forming a nanocomposite material comprising:

dispersing graphene with a surfactant to form a first mixture;

mixing titanium dioxide and water to form a second mixture;

combining the second mixture into the first mixture to form a suspension;

filtering the suspension and calcining the residue to form a titanium dioxide and graphene nanocomposite material wherein the titanium dioxide is in electrical communication with at least one graphene layer;

mixing the titanium dioxide and graphene nanocomposite material with a solvent to form a slurry;

applying the slurry to a current collector; and

evaporating the solvent to form an anode.

12. The method of claim 11 wherein the solvent comprises an organic solvent.

13. The method of claim 11 wherein the solvent comprises poly(tetrafluoroethylene).

14. The method of claim 11 wherein the surfactant comprises cetyl trimethylammonium bromide.